

REMARKS/ARGUMENTS

Reconsideration of this application and entry of the foregoing amendments are respectfully requested.

The claims have been revised to define the invention with additional clarity. Specifically, claim 59 has been revised so as to be drawn to a microporous material which is a non-network polymer. Support for the revision can be found, for example, at page 5, lines 21-22. Claim 65 has been revised so as to be placed in independent, and thus allowable, form. Claim 66 has been revised to include a period at the end of the claim. Claims 67-68 have been redrafted in a manner supported by the first complete paragraph on page 5 of the application. Claims 68 and 69 have been further revised to depend on claims 67 and 68, respectively. Claim 89 has been revised so as to improve legibility of the formula. New claims 90-95 have been added. Claims 90-92 and 93-95 closely follow claims 67-69 but with revised dependencies. That the claims have been revised should not be taken as an indication that Applicants agree with any position taken by the Examiner. Rather, the revisions are offered merely to advance prosecution and Applicants reserve the right to pursue any deleted subject matter in a continuing application.

The Examiner's comments regarding claim 88 are noted and the objection will be addressed when allowance of claim 66 and/or 88 is indicated.

Claims 59-64, 66, 69-72, 83, 85 and 88 stand rejected under 35 USC 102(a) as allegedly being anticipated by, or, in the alternative, under 35 USC 103, as allegedly being obvious over, WO 03/000774 or, alternatively McKeown (US 2004/0198587). Withdrawal of the rejection is submitted to be in order for the reasons that follow.

While Applicants do not concede that the rejection is well founded, claim 59 has been amended so as to further distinguish the invention from the cited art. More specifically, claim 59 as now presented specifies that the microporous material is a "non-network" polymer.

For the Examiner's information, the international application that published as WO 2003/000774 is PCT/GB02/02838, which is referred to as 2002/002838 on pages 2 and 5 of the present specification.

All of the polymers in the cited art are network polymers. The structure of such networks is explained in the paragraph beginning at page 2, line 6 of the present specification. The fact that the polymers of the invention are "non-network" polymers is explained at page 5, lines 20-24.

The Examiner's attention is directed to the structure of the network polymers as depicted by formulae (II) and (III) on pages 2, and 3, respectively, of US 2004/0198587.

Amended claim 59 is distinguished from US 2004/0198587 by virtue of the reference to "non-network" polymers. "Non-network" polymers in the context of the present invention can either be linear or branched: they do not, however, form a network.

It will be apparent from the above that claim 59 as now presented is clearly novel over US 2004/0198587. Accordingly, withdrawal of the rejection insofar as it is based on anticipation is in order and same is requested.

The Examiner offers nothing to support his contention that claims 59-64, 66, 69-72, 83, 85 and 88 would have been obvious over US 2004/0198587, if not anticipated thereby. Nonetheless, Applicants offer the following comments which, it is believed,

explain why the subject matter of these claims would not have been obvious over the cited reference.

The polymers of the present invention provide microporous materials. Prior to the present invention, the general trend in the art was for microporous organic polymeric materials to be network polymers. This was, of course, the approach adopted in US 2004/0198587. Such a rigid network allows the monomer residues (which go to make up the polymeric material) to be held in a "rigid framework" which provides the microporosity. By way of further reference, enclosed is a copy of a review article authored by Tsyurupa and Davankov. This article describes the effect of hypercross-linking in the context of polystyrene networks and how the cross-linking is important in obtaining an:

"Openwork structure [which] is easily accessible to molecules of inert gases as well as to relatively large organic molecules."

(See paragraph bridging the two columns on page 196.)

The present invention went against the trend in the art at the relevant date in that Applicants surprisingly found that it was possible to produce microporous materials which are "non-network" organic polymers, such materials being as defined in claim 59. For this reason alone, the non-obviousness of the invention should be clear.

At the bottom of page 3 of the Action, the Examiner equates structural units as appearing in claims 63, 64, (89) and 66, (88) with "corresponding structural units" in US 2004/0198587. Generally speaking, the Examiner is correct in that similar structural units are involved. **However**, claim 59 as now presented makes it clear that, in the

present invention, these structural units are in the context of “non-network” polymers rather than the “network” polymers of the citation. For the reasons outlined above, it would not have been obvious to modify the “network” polymers of the cited document to arrive at the “non-network” polymers of the present invention, albeit similar structural units are involved.

A further point is worthy of note in relation to present claims 66 and 88, against which the Examiner has referred to formulae X and XII in the cited document. These latter two formulae are actually monomer units used in production of the network polymers of the cited art. At each end of the monomers X and XII, there are two cyano groups that are *ortho* to each other on a benzene ring (which is itself part of a fused ring system). The cyano groups are *ortho* to each other because they are required to be in this position for the formation of the porphyrinic macrocycle which is an essential part of the polymers disclosed in the cited document - the porphyrinic macrocycle is shown as formula (I). The conversion of monomers having cyano groups *ortho* to each other to a porphyrinic macrocycle is schematically illustrated in paragraph [0045] of US 2004/0198587. This reaction to form the porphyrinic macrocycle will not proceed if the two cyano groups are other than *ortho* to each other. Consequential to this reaction, you will note that the cyano groups become “incorporated” in the porphyrinic macrocycle and do not remain as “free cyano” groups in the final polymer.

In contrast, the polymers defined in claims 66 and 88 actually have free cyano groups that are *para* to each other on a benzene nucleus. The fact that the *para* cyano groups remain in the polymers of claim 66 and 68 can be understood from the reaction scheme shown in Example 1 of the present application. The two cyano groups are *para*

to each other and provide electron withdrawing groups that allow the substitution reaction to proceed, the cyano groups remaining "intact" at the end of the reaction.

As regards the Examiner's comment at the top of page 4 of the Action relating to claims 67 and 69, attention is directed to the revised wording of those claims as presented above. In the cited document, the first planar species (the porphyrinic macrocycle) will be connected by the rigid linkers predominantly to three or four other planar species (porphyrinic macrocycles (see the structure of the network polymer as depicted in formulae (II) and, (III) and (VI) of the cited document (formulae VI at the top of page 4 of the cited document))).

A feature of the network materials as disclosed in the cited document is that they are very insoluble. More specifically, these materials are "covalent networks", in which every unit is connected to all other units and to the macroscopic phase boundary by many paths through the polymer phase, the permanent paths through the structure being formed by covalent bonds. A covalent network, by definition, cannot dissolve to form a molecular solution without breaking covalent bonds, although it may, of course, absorb and swell in a solvent to give a gel. The fact that the network polymers are insoluble can be seen from the Examples of the cited reference. It will be noted that, in all of the Examples, the polymers produced are washed exhaustively using a Soxhlet extractor with hot solvents (usually hot methanol and then hot THF or though Example 3 does use hot acetic acid, hot methanol and hot THF in that sequence).

In view of their insolubility, the materials of the cited document cannot easily be formed into membranes by conventional solvent casting techniques. There is a reference in US 2004/0198587 to formation of membranes from the network polymers

(see Paragraph [0056]) but these are not produced by solvent casting techniques.

Furthermore, a thin film can be prepared of a network polymer if it can be polymerized in that form, or if an oligomeric precursor can be further reacted to create the network (as in compression moulding of thermoset resins). In some cases, a membrane can be prepared by compressing a powder. It may also be possible to prepare a dispersion or suspension (as opposed to a solution) of a network in (nano)particle or microgel form, and cast a film from that. However, none of these processes involve a true solution of the network.

In contrast, polymers of the present invention are made up of individual macromolecules which can, at least in principle, be separated out by a solvent without breaking covalent bonds. In practice, of course, it may be difficult to dissolve a non-network polymer, even in a thermodynamically good solvent, because it is difficult for the solvent to gain access (e.g., if the polymer exhibits strong intermolecular interactions).

Further, materials in accordance with the present invention have greater solubility. The polymers of claim 66/88 ("PIM-1") and claim 64 ("PIM-7") are soluble in chloroform, chlorobenzene, o-dichlorobenzene and 1,2,4-trichlorobenzene. "PIM-1 is additionally soluble in tetrahydrofuran (THF). These solutions allow the fabrication of membranes by solvent casting. This procedure involves producing a solution of the polymer (in appropriate solvent) casting a "layer" of the solution onto a substrate, and evaporating the solvent to leave the membrane.

Enclosed as Appendix I are pictures relating to PIM-1, particularly production of a solution thereof in tetrahydrofuran (a) as obtained from the original polymer (b) and pictures of membranes cast from the solution (c, e and f).

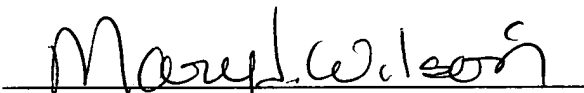
It will be clear from the above that the cited art does not teach, nor would it have suggested, the subject matter of the claims as now presented. Accordingly, reconsideration is requested.

The Declaration filed May 12, 2008 includes a hand-amendment to the address of inventor Msayib. Please substitute the attached Declaration for that filed May 12, 2008.

This application is submitted to be in condition for allowance and a Notice to that effect is requested.

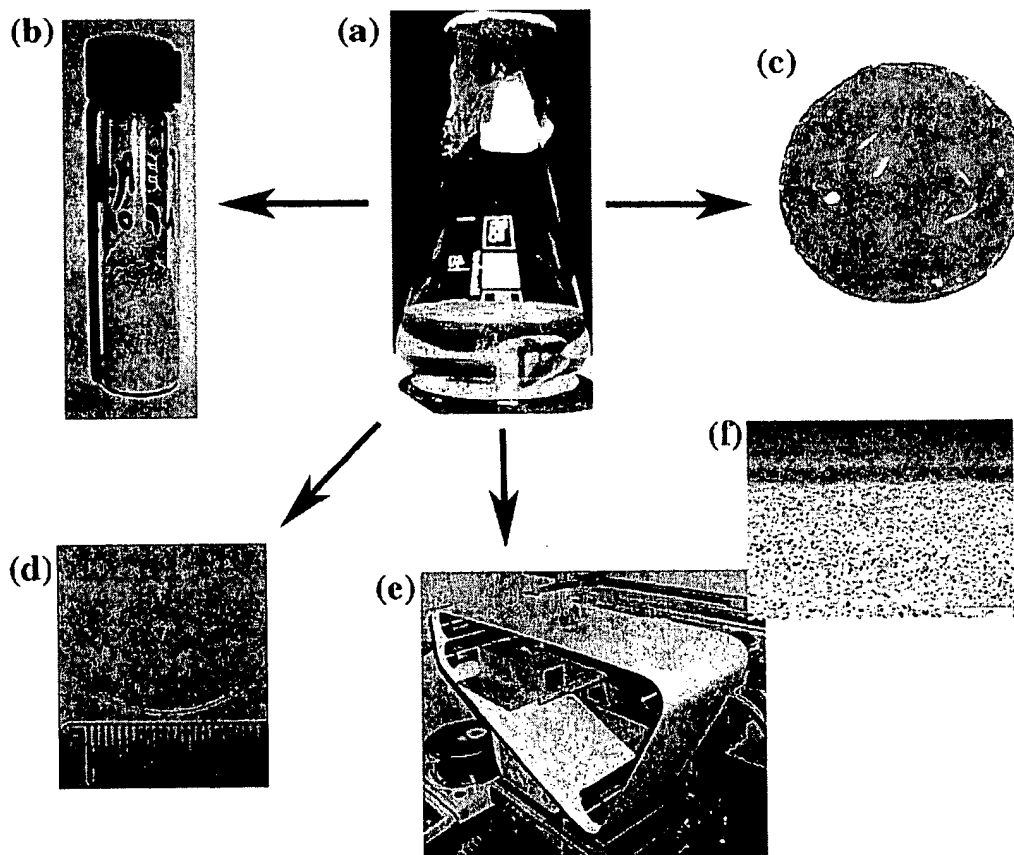
Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 
Mary J. Wilson
Reg. No. 32,955

MJW:tat
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100

APPENDIX I



(a) PIM-1 solution in tetrahydrofuran (THF); (b) precipitated PIM-1 powder; (c) a solvent-cast free-standing film; (d) coated alumina beads; (e) PIM-1 being coated on a macroporous polyacrylonitrile sheet for use as a gas separation membrane; and (f) an electron micrograph showing a 0.5 mm thick coating of PIM-1 on a macroporous support.